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Preface

Agriculture is sensitive to the changes in weather and climate and the occurrence of extreme events from temperature, precipitation, or severe storms further threaten agricultural systems. Normal variations in weather throughout a growing season of among growing seasons of crops cause variations in production and increased risk. Couple these typical variations with extreme events which are at the ends of the expected ranges of climate variables and the effects could be large in terms of production amounts and economic returns. In 2014, an international symposium hosted by FAO, WMO, and George Mason University called the "International Symposium on Weather and Climate Extremes, Food Security, and Biodiversity" was held at George Mason University. This symposium was co-sponsored by United States Department of Agriculture (USDA) and this special issue is developed to showcase the ongoing activities in USDA related to weather and climate extremes.

One of the sessions highlighted the impacts of weather and climate extremes on the natural resource base. Soil erosion will increase with increasing intensity of rainfall events and understanding the current conservation practices being practiced may not be sufficient to provide adequate protection raises the question about what increase in the intensity of conservation practices will be needed to protect the soil. The changing distribution of precipitation during the year and often the form of precipitation from snow to rain will continue to increase the potential for larger erosion events. The precipitation regime continues to change in seasonality and intensity of storms leading to the potential for more erosion events and the paper by Garbrecht et al. describes whether conservation practices can offset the impacts of a changing precipitation regime. Another aspect of the precipitation regime is the utilization of ground water for irrigation to offset the impact of drought. Foster outlines why the capacity of wells are important component in assessing the impact of drought.

An extreme event which is rarely discussed is wind storms leading to wind erosion events. Sharratt and co-authors show that under climate change we have the potential for more wind erosion events and similar to the paper by Garbrecht et al. demonstrate the need for enhanced conservation practices to protect the soil surface. Protection of the soil surface is necessary in wind erosion, like water erosion, to dissipate the energy from dislodging soil particles. In the case of wind erosion these particles are transported into the air in the moving streams of air while in water erosion are dislodged and are transported in the moving stream of water. With more intense wind events, more protection of the soil surface will be needed to avoid erosion.

Frost as an extreme weather event has been well-documented and the effects known to the agricultural community. High temperature events have not been studied as much because these have been relatively uncommon until now but are projected to become more frequent. High temperature impacts on plants were reviewed by Hatfield and Prueger with results from experiments on maize showing the negative impact of high temperature events at the time of pollination. Maize plants exposed to high temperature events of 5C above normal for 5 days at pollination decreased grain yield by over 70% even under conditions with no water deficits. Adaptation strategies to cope with high temperature events will be more complex than low temperature events and will offer a challenge to the research community.

There are research needs outlined in each of these papers which will lead to improved understanding of the impacts of extreme events. The impacts of this research will lead to improved adaptation strategies to cope with extreme events.

One session (Weather and Climate Extremes: Impact on Global Agricultural) focused on various activities designed to identify – and mitigate – the impacts of drought and other weather and climate phenomena on agricultural production. The speakers represented agencies from within the United States Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA) that provide products and services to the Nation's farming communities. Although these agencies have a long and successful partnership dating back to the late 1800s, the drought which has gripped much of the nation since 2012 brought attention to the strengths and weaknesses of programs designed to serve the public in this capacity. To illustrate the point, speakers described how weather and climate extremes impacting agricultural production are monitored and the steps taken to relay this information to the public. The presentations provided a good overview of the current capacity of the Nation to monitor and assess the impacts of weather and climate on agriculture, and what challenges lie ahead in the face of a changing climate and demographics.

A second session dealt primarily with the impacts of weather and climate extremes on agriculture, with topics ranging from classification and mitigation of drought in the United States to analyzing and developing response programs internationally. The USDA has a long history of working closely with the National Weather Service, having for many years been the parent agency of the organization, and is recognized as a leader among other Federal agencies in the area of drought and other weather phenomena having a significant impact on agricultural production. These activities have increased dramatically in the wake of a significant drought that developed on the Great Plains, an important

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producer of grains, oilseeds, and cotton. The paper by Rippey provides an overview of the drought, which was ranked as one of the worst to strike that part of the country. As an author of the *U.S. Drought Monitor*, Rippey offers a unique perspective on the historical significance of the drought, both in terms of thresholds met and the impacts on agricultural production.

As the drought shifted westward, USDA became involved in several new programs designed to provide decision makers with the tools necessary to improve the Nation's resilience to drought. Brusberg and Shively gave an overview of activities undertaken by the USDA with its other Federal partners to coordinate relief efforts in California – a key producer of agriculture – and to assess the needs of communities to develop long-term solutions to water-shortages caused by drought as a method of ensuring sustainable agricultural production and economies. Similarly, Shannon and Motha outlined activities designed to manage risk from weather and climate extremes in parts of Central and North America. In recent decades, numerous weather- and climate-related natural disasters have impacted North America, Central America, and the Caribbean, repeatedly demonstrating how vulnerable local agriculture is to extreme episodic events. Some farmers in this region already apply various strategies to help reduce weather and climate risks and uncertainties, but others do not; however, the agrometeorological community can help overcome these obstacles by building upon existing efforts that have successfully educated farmers about weather and climate risks to agriculture and have equipped farmers with the data, tools, and applications necessary to manage these risks.

USDA's economic interests in the global impacts of weather and climate on agriculture are examined by Johansson, et.al. Agricultural meteorologists employed by the Department's Office of the Chief Economist routinely monitor weather extremes in international crop areas to provide weather intelligence for the *World Agricultural Supply and Demand Estimates* report, a major economic report issued monthly by USDA. Several examples are provided where weather and climate phenomena played a large role in how analysts viewed the situation in areas that could have potentially affected American farmers given the global nature of agricultural markets.

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